

Formulae - Mechanics

Velocity (m/s) $v = d / t$ & $v = u + at$ & $v = \sqrt{u^2 + 2ad}$

Distance (m) $d = \frac{1}{2}(u + v) t$ & $d = ut + \frac{1}{2}at^2$

Acceleration (m/s²) $a = \Delta v / t$

Acceleration due to gravity (g) = 9.81m/s²

Force (N) $F = ma$ (mass measured in kg)

Frictional Force = mgf

Weight (N) = mg

Momentum (kg/m/s) $M = mv$

Work (J) $W = Fd$

Power (W) = $W/t = Fd/t = Fv$

Pressure (N/m²) $P = F/A$

Potential Energy (J) $E_p = mgh$

Kinetic Energy (J) $E_k = \frac{1}{2}mv^2$

Density (kg/m³) $\rho = m/vol$

Formulae - Electricity

Voltage (Volts) = V

Current (Amps) = $I = \frac{V}{R}$

Resistance (Ohms) = R

Power (Watts) = VI

R tot (series) = $R_1 + R_2 + R_3 + \dots$

R tot (parallel) = $1/R_1 + 1/R_2 + 1/R_3 + \dots$

Formulae - Hydraulics

1 bar = 100 kpa = 10 metres head = 100,000 N/m²

Flow (l/min) $L = \frac{vd^2}{21.2}$ $L = \frac{2}{3}d^2\sqrt{P}$ (pressure in bar)

Nozzle Output (l/s) = $0.0011d^2\sqrt{P}$ (pressure in kpa , nozzle diameter in mm)

Velocity (m/s) $v = \frac{21.2L}{d^2}$

Pressure loss due to friction (kpa) $P_f = \frac{2000fv^2}{d}$ (hose diameter in mm)

Head loss due to friction (metres head) $H_f = \frac{2fv^2}{Dg}$ (hose diameter in m)

Metres Head (m) $H_m = \frac{v^2}{2g}$ Velocity(m/s) $v = \sqrt{2gh}$

Jet Reaction $J_f = 2Pa$ & $J_r = 1.57Pd^2$

1. 1000

Theoretical Height of Jet (m) $H_t = H_m - (0.113 H_m^2/d)$

Effective Height of Jet (m) $H_e = \frac{2}{3} (H_t)$

Water Power (watts) $WP = l/s \times P$

Brake Power (watts) $BP = WP/E$ Pump Efficiency = $WP/BP \times 100\%$

Capacity of a water main = $\frac{\sqrt{SP}}{D}$ x l/s

D

Capacity of hose = $\frac{7.854 d^2}{10000}$

Formulae - Heat

$$\text{Kelvin (K)} = ^\circ\text{C} + 273$$

$$^\circ\text{F} = (^\circ\text{C} \times 9/5) + 32 \quad ^\circ\text{C} = (^\circ\text{F} - 32)5/9$$

$$\begin{aligned} \text{Heat Absorbed/Released (kJ)} \\ = \text{specific heat (kJ/kg}^\circ\text{C)} \times m \times \Delta T \end{aligned}$$

$$= \text{latent or fusion heat(kJ/kg)} \times m$$

$$\text{Linear Expansion } \Delta L = L_0 \times \text{co-eff linear exp.} \times \Delta T$$

Boyles Law = volume of a gas is inversely proportional to its pressure for a given mass at a constant temperature

$$P_1V_1 = P_2V_2$$

Charles Law = volume of a gas is directly proportional to its kelvin temp for a given mass at constant temperature

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$T_1 \quad T_2$$

Guy Lussacs Law = the pressure of a gas is directly proportional to its kelvin temperature for a given mass at a constant volume

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$\text{Combined Gas Law} = \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$